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Oil-bearing Plant Genomics

An Epigenetic Approach of Somaclonal Variation in the Oil Palm

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The oil palm is a non-model crop

- Oil palm is the 1st source source for vegetable oil
- Fat consumption for food and energy is increasing with growing population and living standards
- A vector for development and poverty alleviation
- A strategic crop in South East Asia

The oil palm is a non-model crop

- A tropical perennial Monocot
- Very limited genomic resources to date
- Research in genomics is scattered amongst National Institutions and private sector
- Three different Genome Sequencing Initiatives
- No genome sequence publicly available to date

… but it provides an amazing model !

- Large scale micropropagation has generated somaclonal variation
- Public/private partnership fuels the search for basic knowledge
- The *mantled* floral phenotype provides an original support for epigenetic studies

« Things written in pen you can't change.

That's DNA.

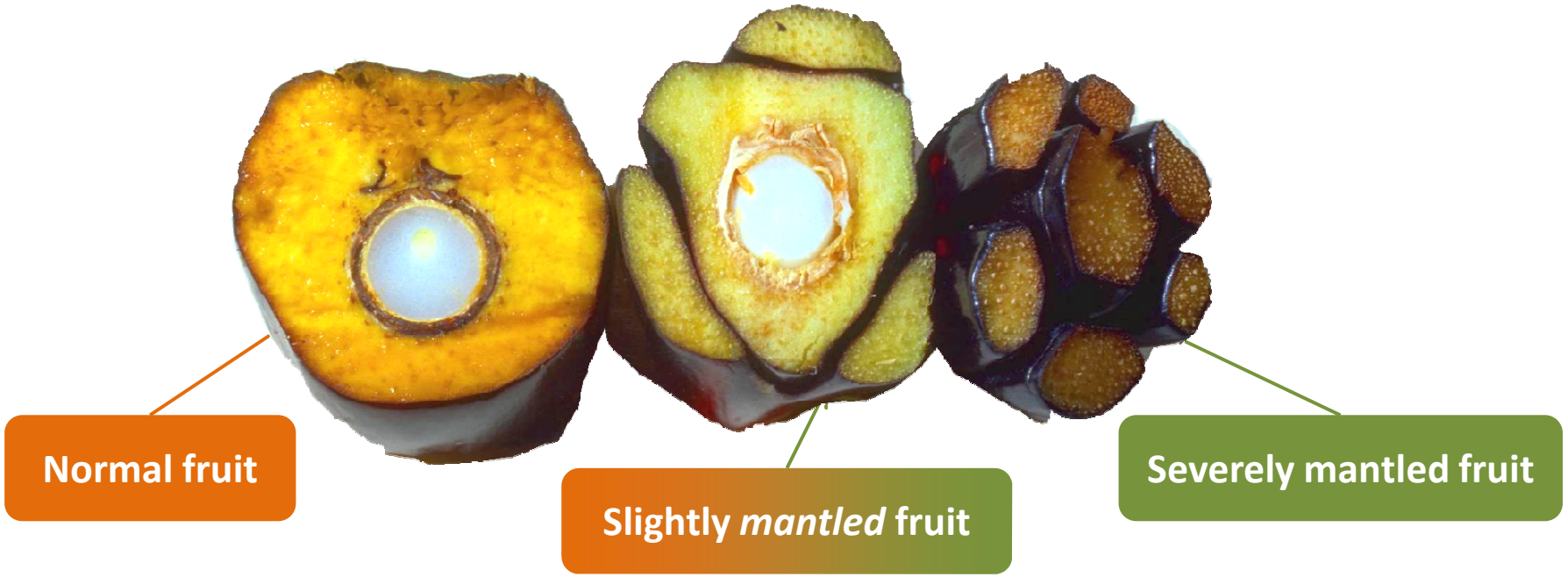
But things written in pencil you can.

That's epigenetics »

Danielle Reed

Geneticist

The *mantled* phenotype



- Somaclonal variation: arises from *in vitro* cloning
- Alteration of floral organs: poor oil accumulation, infertility,
- Observable in adult trees only
- Highly heterogeneous: frequency, severity, genotype effect
- Unstable: spontaneous reversion

Tackling *mantled*ness from both ends

Somatic Embryogenesis

Embryogenic cell culture

Adult regenerant palm

- On adult clonal palms: understanding the molecular origin of the floral phenotype
- On *in vitro* cultures: generating and assessing potential markers for early detection

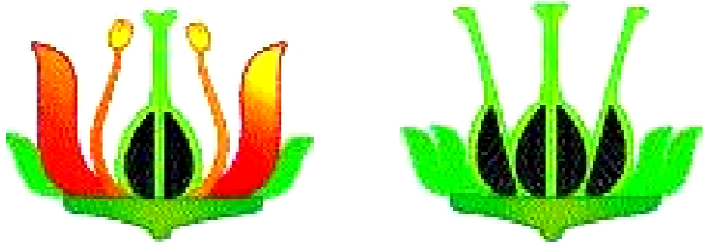
A few things we know

- No cytogenetic alteration
- Non-mendelian inheritance
- Hypomethylated genome

-19.3%

-7.4%

- Altered gene transcription
- Phenotype: stamen converted into carpels, reminiscent of B-class MADS-box gene mutants



The hypotheses

1. Epigenetic mechanisms regulating gene expression are affected by somatic embryogenesis

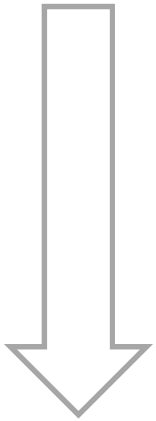
2. Somatic embryogensis driven by cycles of dedifferentiation / redifferentiation under the control of plant growth regulators,

3. The pathway governing the identity of flower whorls remains modified at the adult stage.

The strategy

- *In vitro* material: investigating the genomic and epigenetic stability during the tissue culture process

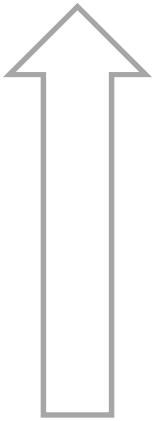
Follow-up on the phenotypic stability in the field



- Adult (inflorescence) material: exploring the epigenetic regulation of flower development

The strategy

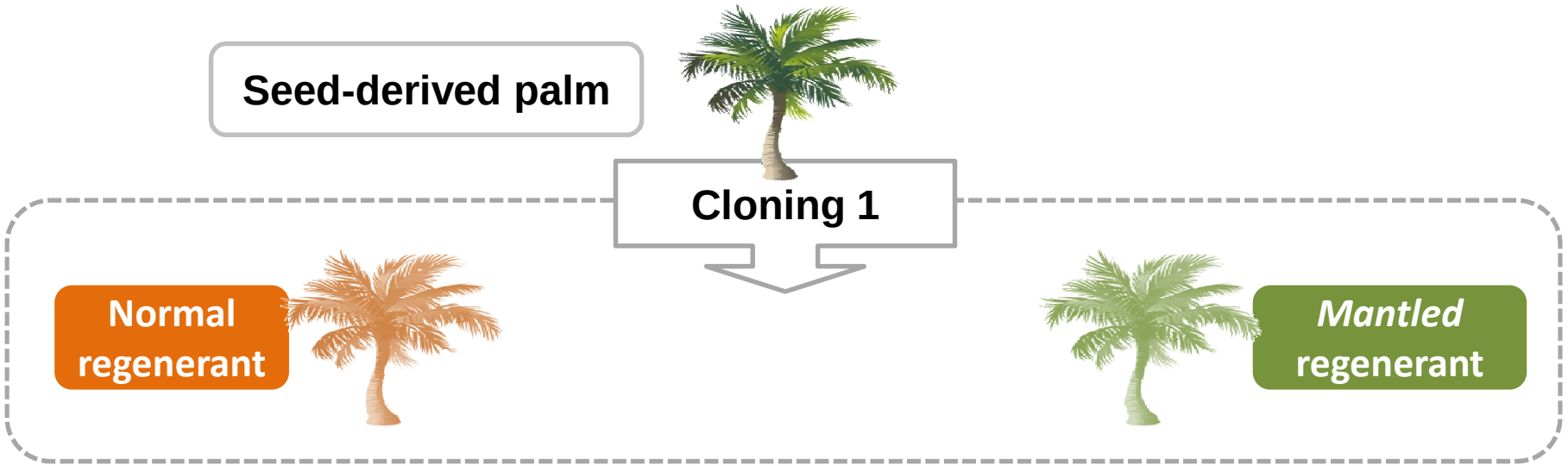
- *In vitro* material: investigating the genomic and epigenetic stability during the tissue culture process



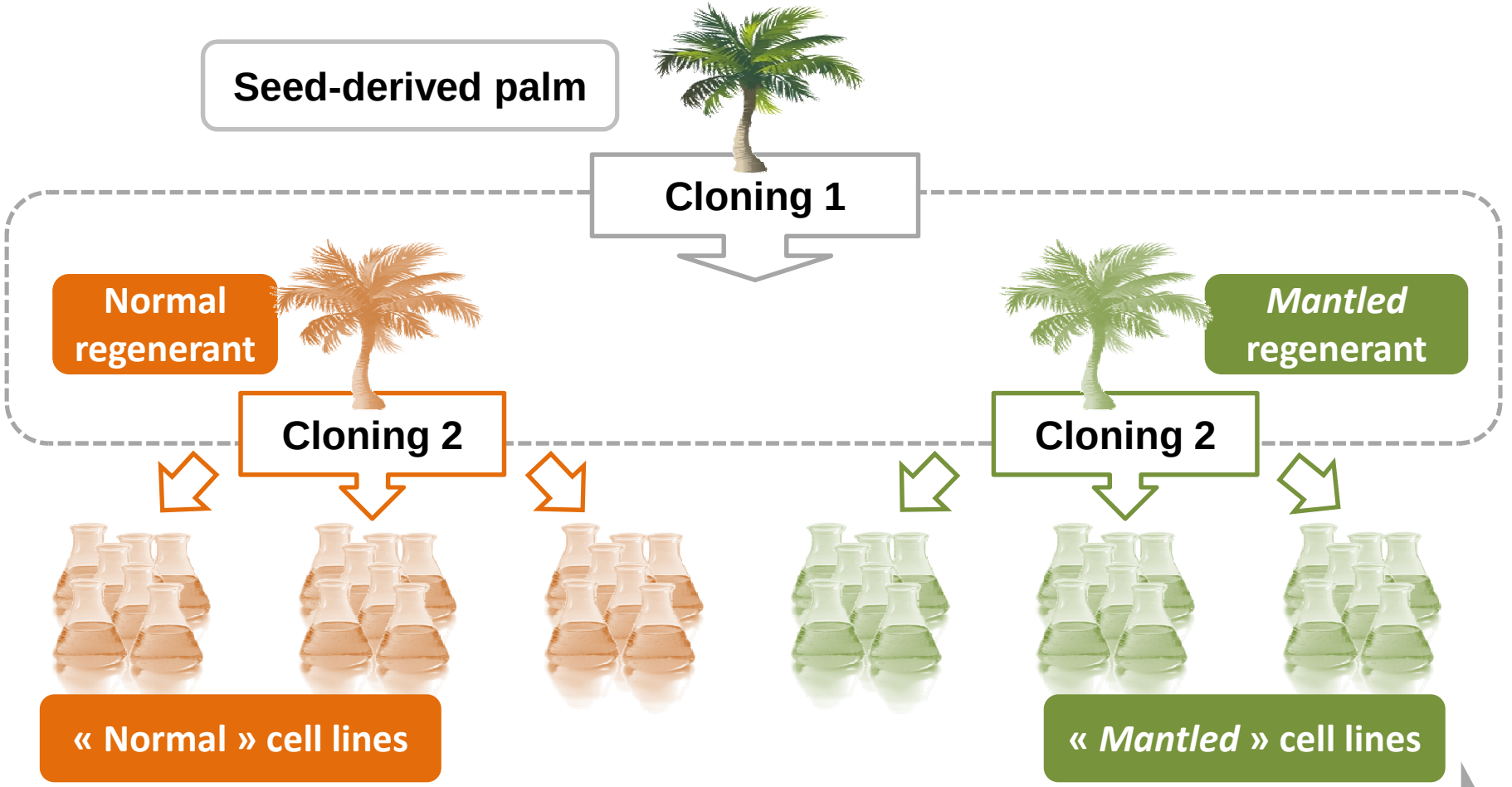
Tracing back the origin of the *mantled* phenotype

- Adult (inflorescence) material: exploring the epigenetic regulation of flower development

Investigating the stability of cell cultures



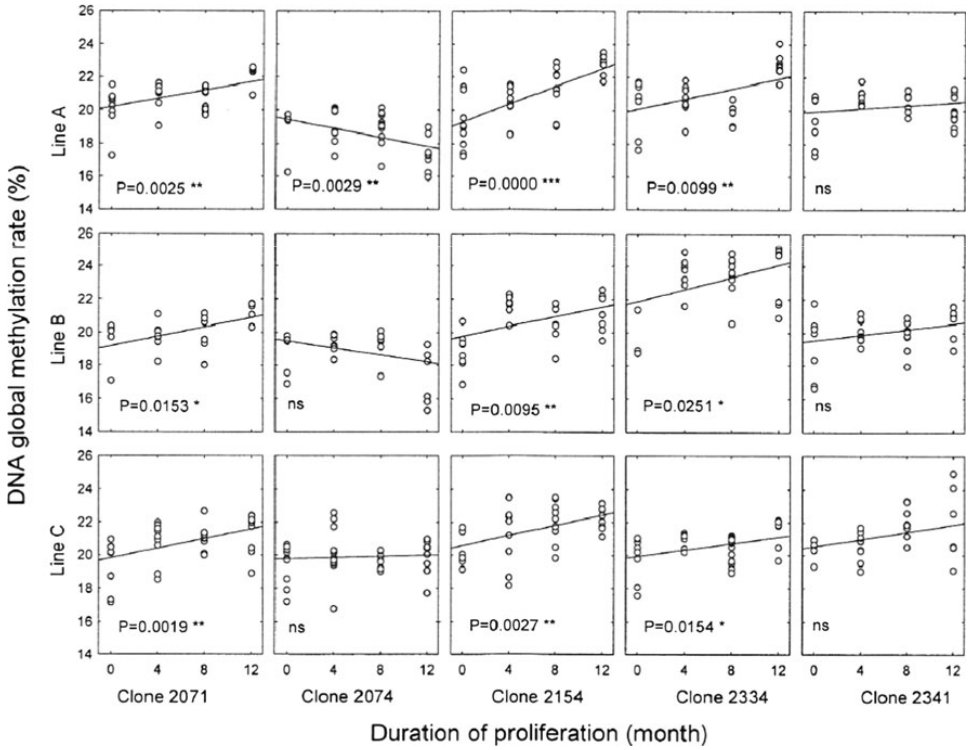
Investigating the stability of cell cultures



Propagation over 1 year, periodical samplings for DNA/RNA extractions

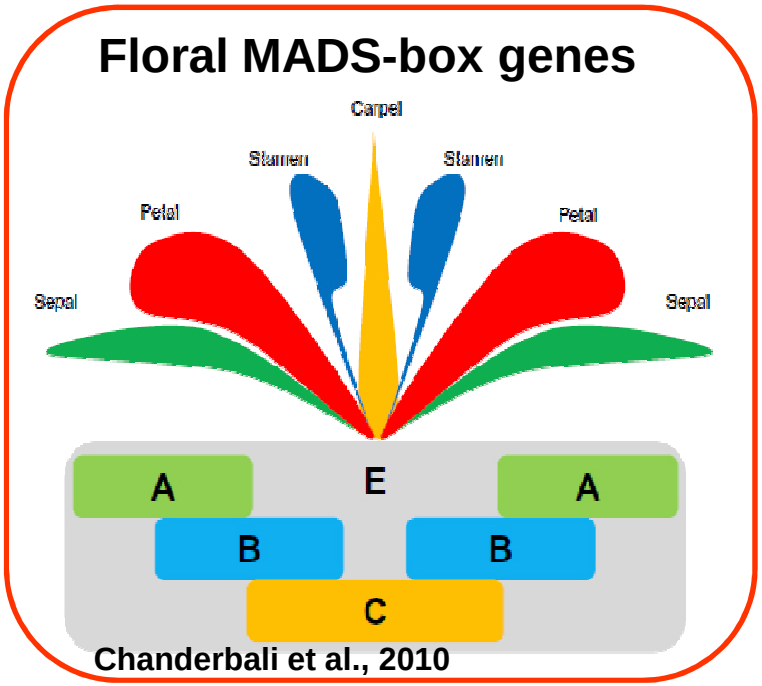
Investigating the stability of cell cultures

- ***Global DNA methylation rates***



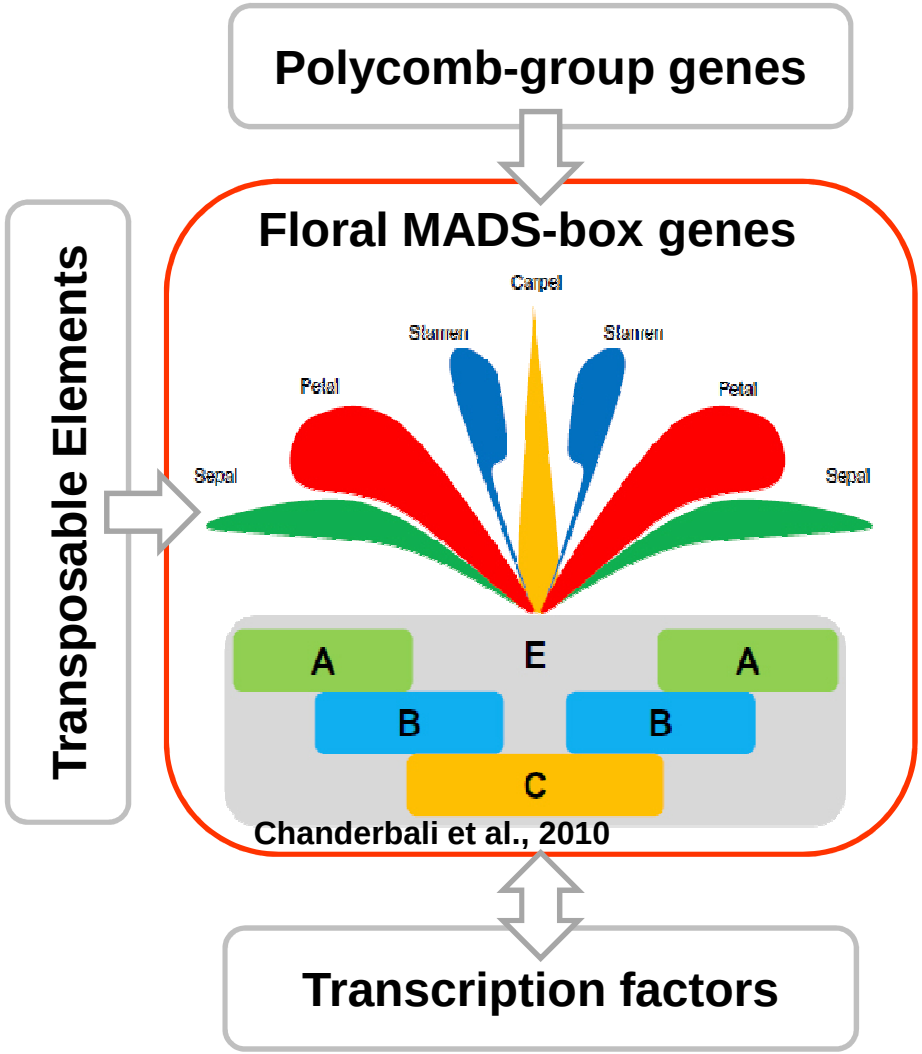
- ***S-Sap Analysis of Transposable Elements***
- ***Transcriptomics analysis, Q-PCR on target sequences***

Exploring the epigenetic regulation of flower development



Chanderbali et al., 2010

Exploring the epigenetic regulation of flower development

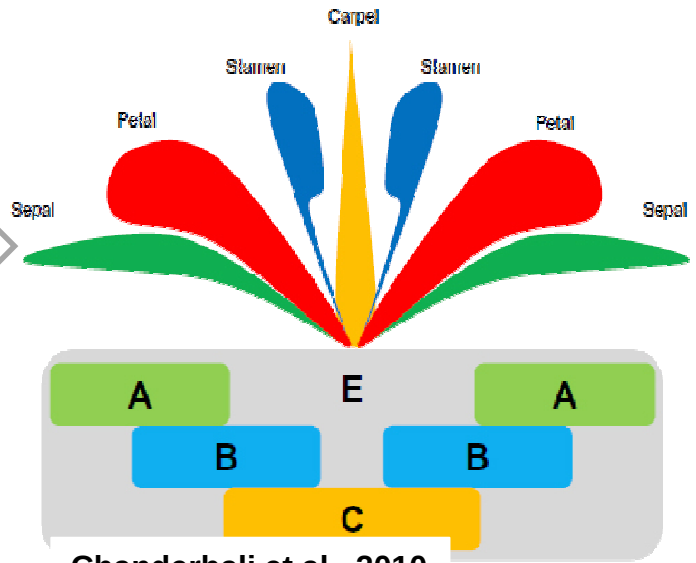


Exploring the epigenetic regulation of flower development

Polycomb-group genes

Floral MADS-box genes

Transposable Elements



Chanderbali et al., 2010

Transcription factors

Different epigenetic marks in *mantled* flowers?

Bisulfite sequencing, ChIP

Different mRNA/sRNA levels in *mantled* flowers?

RNAseq, Q-PCR

Recent articles

• Rival et al., 2012: Variations in genomic DNA methylation during the long-term in vitro proliferation of oil palm embryogenic suspension cultures. *Plant Cell Reports*, 32(3) : 359-368.

• Jaligot et al., 2011: Epigenetic imbalance and the floral developmental abnormality of oil palm. *Annals of Botany* 108, 1453-1462.

• Rival, Jaligot et al. 2008: Isolation and differential expression of MET, CMT and DRM methyltransferase genes from oil palm (*Elaeis guineensis* Jaq.) in relation with the "mantled" somaclonal variation. *Journal of Experimental Botany* 59(12): 3271–3281.

Thank you for your kind attention

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